





Experiment P-53 Partial Vacuum



Objectives

- To study the concept of vacuum and partial vacuum.
- To investigate how pumping out air from a box affect the pressure inside.
- To investigate how the change of pressure affects a balloon and a marshmallow that are in the box.

Modules and Sensors

- PC + NeuLog application
- USB-200 module 
- BAT-200 battery module 
- Two RF-200 RF communication modules 
- NUL-210 Pressure logger sensor 

Equipment and Accessories

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| ▪ Vacuum box |
| ▪ Vacuum pump |
| ▪ Balloon |

- The items above are included in the NeuLog Environmental chamber kit, HUM-KIT.

Materials

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|---------------|
| ▪ Marshmallow |
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Introduction

Pressure is a force exerted by a substance per unit area on another substance. The pressure of a gas is the force exerted on the walls of a container by the gas inside it.

In everyday usage, vacuum is a volume of space empty of matter and its gaseous pressure is much lower than the atmospheric pressure. The word comes from the Latin term for "empty", *Vaccus*. It is impossible to achieve a perfect vacuum, one with no particles at all. A partial vacuum is defined as an enclosed space from which part of the air or another gas has been removed.

In this experiment we will pump out air out of a box in order to create a partial vacuum. We will measure the pressure inside during this process. We will also investigate how the low pressure affects a balloon or a marshmallow inside the box.

Procedure

Experiment setup

1. Set up the experiment as shown in the picture below.



2. Inflate the balloon a little and tie a knot at its end.
3. Place it inside the vacuum box.

4. Connect a charged battery module to an RF module and a pressure sensor.
5. Place the connected modules and sensors in the vacuum box.
6. Close the box.
7. Connect the other RF module to a USB module.

Sensor setup


8. Connect the USB-200 module  to the PC.

Note:


The following software functions are explained in short. It is recommended to practice the NeuLog application functions (as described in the user manual) beforehand.

9. Run the NeuLog application and check that the pressure sensor is identified.
10. If the sensor is not identified, make sure that the battery is charged (the led will turn on when pressing on its button). Also, make sure that the RF modules have the same ID number. In order to change their ID number look at the RF module user guide in the NeuLog website.




Settings

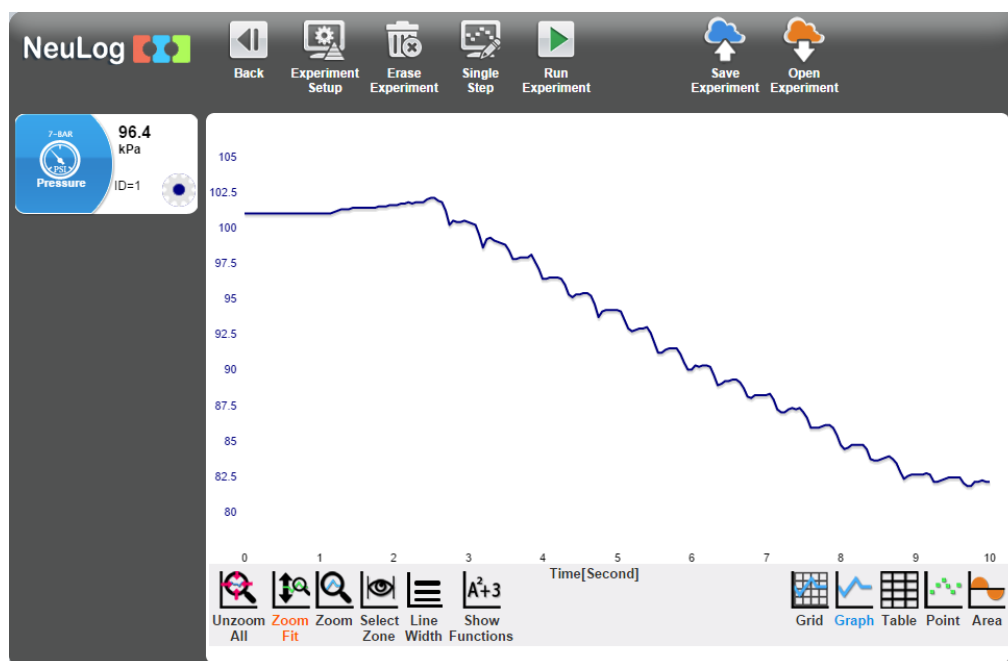
11. Click on the **On-line Experiment** icon  in the NeuLog main icon bar.
12. Click on the pressure **sensor's module** box.
13. Click on the **Range** button.
14. Select the kPa button to set the sensor's mode.



15. Click on the **Experiment Setup** icon  and set the:
 Experiment duration to 10 seconds
 Sampling rate to 20 per second

Testing and measurements

16. Click on the **Run Experiment** icon  to start the measurement.
17. Take the vacuum pump and place it above the valve of the box.
18. Pump the air out of the box at least 15 times and watch what happens to the balloon during the process.
19. In order to focus on the desired range, click on the **Zoom** icon , locate the mouse cursor at a point above the graph and press its left button; keep it pressed and create a rectangle that includes the whole range. Alternatively, click on the **Zoom fit** icon .
20. Your graph should be similar to the following:



21. Save your graph.
22. We can see that every time some air is pumped out of the box, the pressure decreases. At one point, it gets harder to

pump more air out and the pressure does not decrease anymore.

Challenge research

23. Repeat the experiment, but this time use a marshmallow instead of the balloon.

Summary questions

1. Explain what happens to the balloon and the marshmallow when you pumped out the air from the box?
2. What happens to an exposed human in space? How is it connected to this experiment?
3. What would happen to a balloon filled with helium inside a container with atmospheric pressure? What would happen to it in a vacuum?
4. Write two applications for a partial vacuum in everyday life.